Space Weather Technical Forecast

Issued on Saturday, 22 January 2022 at 00:54 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance G1/Minor Storm intervals from CME arrivals throughout. Active high energy electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low in the past 24 hours, with no significant X-ray flares recorded. The number of sunspots on the visible disc is now just two, both unipolar groups. 2933 (Hax/Alpha), approaching the southwest horizon, and 2934 (Hsx/Alpha), located towards the east of the southeast quadrant.

At 21/0900UTC, a large filament disappeared from immediately north of AR2934, with a Coronal Mass Ejection (CME) following. However, results of modelling suggest the vast majority of ejecta is directed away from Earth, and is not expected to give any impacts. No other Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was at slightly elevated levels, 400-500km/s, although showed a weak enhancement around 21/1315UTC, which along with the other solar wind parameters appeared to indicate the arrival of a weak CME, most likely from the 18th. Density rose no high than average levels 10ppcc. The Total IMF (Bt) was weak but showed a kick to 7nT with the weak CME arrival. The north-south component (Bz) was also weak but showed a sustained slightly stronger southward trend associated with the weak transient. The phi angle remained predominantly negative (towards the sun). Quiet geomagnetic activity increased to occasionally Unsettled after midday UTC on 21st.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16, was at Background albeit modestly elevated levels, but continued to show a slowly declining response from the recent S1 event. Similarly, the 100 MeV proton flux was initially very slightly elevated but has now returned to background levels. High energy electron flux (greater than 2MeV), measured at GOES 16, was at mostly High levels, with a peak value of 2660pfu at 20/1655 UTC, but has dropped to Moderate levels in recent hours. Electron fluence persisted above the 1e8 Active threshold, with a slight rising then falling trend, and an observation value of 1.41e8 integrated pfu recorded at 22/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is initially a very slight but diminishing chance of isolated M-class flares, however this risk soon passes into the UTC weekend. Very Low solar activity is then expected, with a slight chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are possible CME influences on the first three days of the forecast period. A weak CME is currently passing Earth, most likely a glance from the 18th January CME. A further CME from 19th Jan is possible on the 23rd. On the 24th two CMEs, one from the 20th and another from 21st Jan, could also possibly glance past Earth, although the latter is a very low probability.

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In the absence of the CMEs above, solar winds are expected to be background to slightly elevated in the short term, with an increasing chance of weak high speed stream influence developing from the second half of 23rd onwards, from CH45 and CH46.

The resultant forecast is very low confidence in timing and phasing of G1 risk, but higher for this being the maximum attained geomagnetic activity. Outside of potential transient effects, Quiet to Unsettled activity should give way to more frequent Unsettled periods, with a chance of isolated Active intervals, from later Day 2 (23rd) associated with coronal hole influence.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, still slightly elevated although at Background levels is forecast to continue to slowly decrease in the first half of the forecast period. The chances of any further enhancements should now gradually fall to very low probabilities.

The high energy electron flux (greater than 2MeV) is expected to be continue to at mainly High flux levels throughout the period, but carries low confidence for the likelihood of interruptions from CME arrival and perhaps the more assured reset to lower levels from CH45 and CH46 in the second half of the forecast period. The 24-hour fluence is forecast to persist above the Active threshold initially, but with an increasing chance of dropping below this level into the new week.

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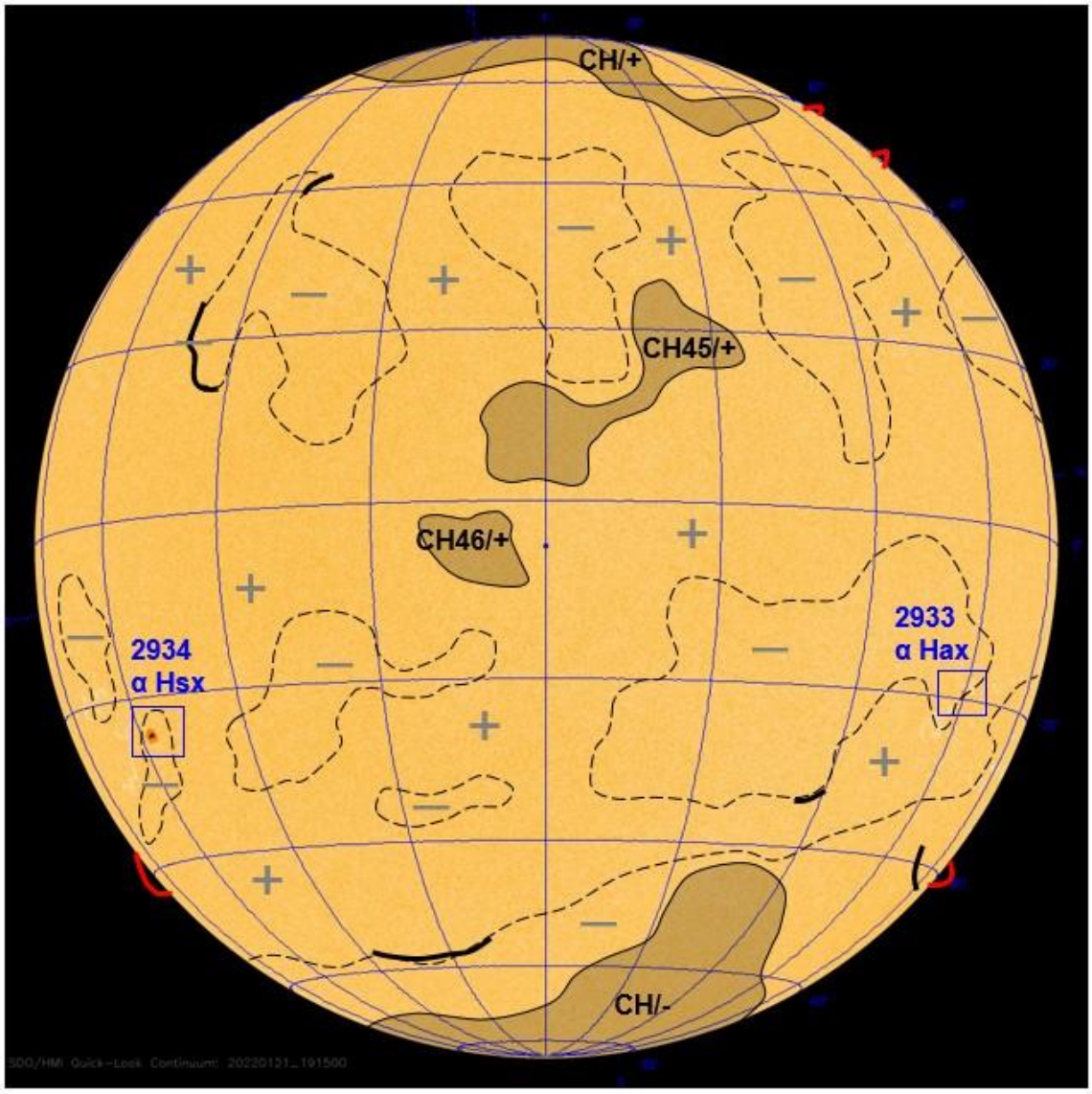
Figure 1. Solar Analysis Valid 21/1930 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are numerous CME influences due in the forecast period. A weak CME is currently passing Earth, most likely a glance from the 18th January CME. A further CME from 19th Jan is then expected to move across Earth on the 23rd. This is a slower and weak CME, but with relatively higher confidence of arrival. The CME associated with the M5 flare on 20th is modelled as missing Earth, however a further CME, associated with an ensuing filament eruption in the southwest quadrant, is modelled as potentially brushing Earth on the 24th. Finally, a filament eruption and subsequent CME near the SE limb on 21st Jan, could also possibly brush past Earth on 24th, but this is considered a very low probability as the vast bulk of the ejecta is directed away from Earth.

In the absence of the CMEs above, solar winds are expected to be background to slightly elevated in the short term, with an increasing chance of weak high speed stream influence developing from the second half of 23rd onwards, from CH45 and CH46.
The resultant forecast is very low confidence in timing and phasing of G1 risk, but higher for this being the maximum attained geomagnetic activity. Outside of potential transient effects, Quiet to Unsettled activity should give way to more frequent Unsettled periods, with a chance of isolated Active intervals, from later Day 2 (23rd) associated with coronal hole influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
18/2140	Partial	M1.5 from AR2929	N11 W56	950	22/0000UTC	Bulk missing, only weak sideswipe. - Appears to have arrived as weak feature 21/1315UTC.
19/1837	Partial	Filament	S16 W17	288	23/1500UTC	Low confidence in fit with imagery.
20/1642	Partial	Filament	S02 W59	478	24/1200UTC	Likely to pass north of Earth

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Radio Blackouts - X-Ray Flares:

There are now just two front-sided sunspot regions on the disc, and neither is likely to prove capable of significant flares in their current form. Ex-2929's recent transit beyond the west limb means there is still initially a very slight but diminishing chance of M-class flares, however this risk soon passes into the UTC weekend. Given the expected lack of returning and newly-developed regions in the region of the sun expected to rotate onto the visible disc in the forecast period, the chances of further significant flares are considered increasingly slim.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The assumed continued presence of Ex-2929 beyond the western limb is maintaining the very slight risk of further S1-level enhancements at first in the forecast period, however this risk should soon decline with continued far-side progression of this group.

With Ex-2929 gone, the remaining sunspot groups are unlikely to sustain such risk levels, with a decay to background level of risk most likely by the end of the UTC weekend.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as measured by GOES-16 at GEO, is currently High after recent fast wind and CME enhancements. The current level is likely to

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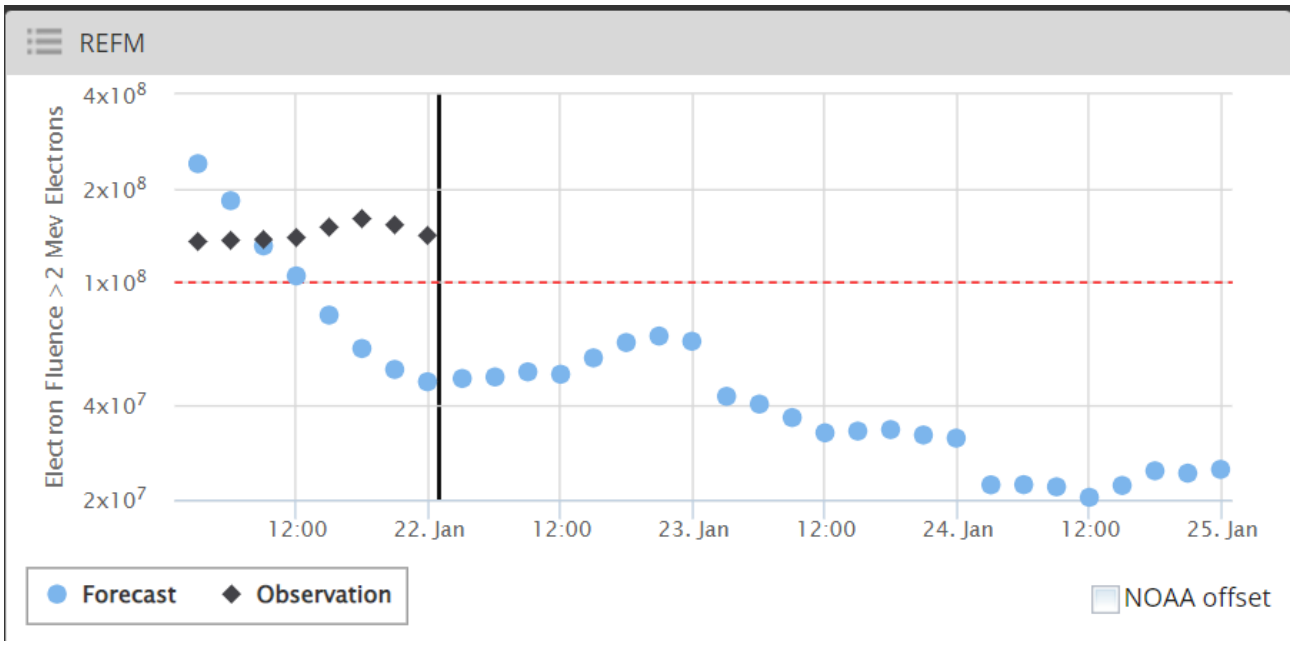
represent the peak of attainment in the period, with detail very low confidence for reliance on the incidence and phasing of so many transients. Of greater confidence is the resetting potential of the coronal hole high speed streams that should take effect in the second half of the forecast, meaning that initial expected Active fluence should give way to a Chance from later in the UTC weekend, probably not re-establishing at current levels into the next working week.

Again because of the heavily transient-influenced forecast (or otherwise), over reliance on REFM's signal is advised against, however the advertised general downward trend is accepted.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	70	40	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM.



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